

SECTION 13085

SEISMIC PROTECTION

LANL MASTER CONSTRUCTION SPECIFICATION

This specification section must be edited to suit job specific requirements. When editing, the author shall add job-specific requirements and delete only those portions that are in no way applicable to the construction activity (e.g., a component that does not apply). The ESM Structural POC or his designee shall be contacted for variances from applicable requirements.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Information bracketed by asterisks (*****) should be deleted from project specific specifications.

This specification is based on ESM Chapter 5 – Structural, Part II, Section 2 – Design and Analysis Requirements for PC-1 and PC-2 Nonstructural Components and Non-Building Structures. It is strictly applicable to ML-3 and ML-4 projects. Seismic bracing and anchorage must be specifically designed in accordance with ESM Chapter 5 requirements for ML-1 and ML-2 projects.

Much of ESM Chapter 5 – Structural, Part II, Section 2 – Design and Analysis Requirements for PC-1 and PC-2 Nonstructural Components and Non-Building Structures is based on ASCE 7-02 and IBC 2003. Most of the provisions pertaining to seismic protection measures are not contained in this specification section; therefore, it is incumbent on the author to consult these documents, along with this specification section, for the design of seismic protection measures. Where there are overlaps between this specification section and the aforementioned documents, or gaps in this specification section, the documents shall govern.

The ESM Chapter 5, Part II provides design and seismic qualification requirements for the supports and anchorage of nonstructural components, equipment and distribution systems, and of non-building structures. The components, equipment, distribution systems and non-building structures themselves shall also be designed for seismic loading and must be seismically qualified using a graded approach. The graded approach considers Management Level, NPH Performance Category, and safety class of the component or system. In many cases, the preceding is provided for in other chapters of the ESM and, accordingly, the associated specification requirements should be provided for in the respective sections of this Specification.

It should be noted that ESM Chapter 5, Part II, Sect. 2 states that the functional and physical interrelationship of components and their effect on each other shall be designed so that the failure of a PC-1 or PC-2 component shall not cause the failure of a PC-2, PC-3, or PC-4 component.

PART 1 GENERAL

NOTE: The intent of this specification is to provide for adequate resistance to lateral forces induced by earthquakes for listed architectural, mechanical, and electrical components and systems, so as to preclude injury or impeded egress of personnel. In addition, this specification is intended to ensure confinement of hazardous material is maintained during and following the design seismic event in components and systems containing such material.

The design seismic lateral forces are in addition to the "normal" gravity forces (weight) acting on the components of a system.

1.1 SECTION INCLUDES

- A. Seismic protection measures for architectural, mechanical, and electrical components and systems located within buildings.

1.2 SYSTEM DESCRIPTION

A. General

1. The requirements for seismic protection measures to be applied to architectural, mechanical, and electrical components and systems specified herein are in addition to any other items called for in other Sections of these Specifications. Where overlap exists, the more stringent of the requirements will govern.

B. Architectural, Mechanical, and Electrical Components

1. Include the following architectural, mechanical, and electrical components to the extent required on plans or in other sections of these specifications:

Water Heaters	Steam, Water, and Gas Piping	Interior Nonstructural Walls
Expansion Tanks	Drain, Waste, and Vent Piping	Partition Walls
Heat Exchangers	Elevators	Exterior Non-Structural Wall Elements
Water Chiller Units	Distribution Bus Ducts	Suspended Ceiling Assemblies
Cooling Towers	Air and Refrigerant Compressor	Parapets
Control Panels	Air Handling Units	Penthouses
Pumps with Motors	Chimneys and Stacks	Laboratory Equipment
Light Fixtures	Circuit Disconnect Devices	Access Floors
Motor Control Centers	Transformers	Appendages and Ornamentation
Switchboards	Storage Racks and Cabinets	Glass in Glazed Curtain Walls
Panel Boards	Ducts	Glazed Partitions
Combination Starters	Veneer	

C. Mechanical Systems

1. Include the following mechanical systems to the extent required on Drawings or in other Sections of these Specifications:
 - a. Gas Distribution
 - b. Water Supply Systems
 - c. Sanitary Sewer Systems
 - d. Process Piping

D. Loading from Seismic Effects and Associated Design

1. Loading shall be determined in accordance with ESM Chapter 5, Part II, Section 2, and design carried out in accordance with same.

E. Exclusion

1. Install seismic protection of plumbing for fire protection systems per NFPA 13, Installation of Sprinkler Systems.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures:

1. Design calculations for bridge cranes and monorails with the shop drawings.
2. Shop Drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Furnish shop drawings complete in detail; indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction.
 - a. Sway Braces
 - b. Flexible Couplings or Joints
 - c. Resilient Type Vibration Devices
 - d. Fume Hood Discharge Stacks
3. Certification of cranes per paragraph 3.12.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Bolts and Nuts

1. Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2; or ASTM A307, ASTM A563, respectively; or ASTM A325. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A153.

B. Sway Brace

NOTE: Designer should determine an appropriate specification for steel angles used for sway bracing depending on availability of the materials from local suppliers and insert the designation in blank space below.

Material used for members listed in this section and on the drawings shall be structural steel conforming with the following:

1. Plates, rods, and rolled shapes, [ASTM A36] [ASTM A572, Grade 503]. If the Contractor does the design, both ASTM A36 and ASTM A572, grade 503 are allowed.
2. Wire rope, ASTM A603.
3. Tubes, ASTM A500, Grade [B] [_____].
4. Pipes, ASTM A53, Type [E] or [S], Grade B.
5. Light gauge angles, less than ¼-inch thickness, [ASTM A653] [_____].

C. Flexible Couplings

1. Provide flexible couplings with the same pressure ratings as adjoining pipe.
2. Flexible ball joints conforming to the following requirements may be employed on above ground piping. Provide joints that have cast or wrought steel casing and ball parts capable of 360 degree rotation plus not less than 15 degree angular movement.
3. Flexible couplings and joints of the mechanical joint type may be used for aboveground or underground piping.
 - a. Use sleeve type mechanical couplings for steel or cast-iron pipe that provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the round, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

- b. Use sleeve-type couplings for joining plain-end pipe sections. Provide couplings consisting of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Use high-strength underground bolts type as specified above.

D. Guy Wires

- 1. Guy wire: Conform to Fed. Spec. RR-W-410, Wire Rope and Strand, as follows:

5/32 inch diameter	Type V, Class 1
3/16 inch to 5/16 diameter	Type V, Class 2
1/4 inch to 5/8 diameter	Type I, Class 2

E. Lighting Fixture Supports

- 1. Fixture supports: Malleable iron.

F. Automatically Actuated Natural Gas Shut-off Valves

- 1. Use of automatically actuated gas shut off-valves is not permitted.

PART 3 EXECUTION

3.1 GENERAL

- A. Seismic protection measures like guy wires, wire rope, etc. shall be installed such that they are taught (i.e., without slack) when the component/system they are protecting is 'at rest.
- B. Seismic protection measures are not required for mechanical and electrical components and systems that:
 - 1. Are mounted at 4 ft. or less above a floor level and weigh 400 lb. or less, are not critical to the continued operation of the structure and will not create a hazard by its failure or the failure of distribution components connected to it.
 - 2. Weigh 20 lb. or less or, for distribution systems not containing hazardous substances, weigh 5 lb./ft. or less.
- C. Seismic protection measures are not required for HVAC ducts with an Importance Factor (I_p) of 1.0 if either of the following conditions are met:
 - 1. HVAC ducts are suspended from hangers 12 or less in length from the top of the duct to the supporting structure. The hangers shall be detailed to avoid significant bending of the hangers and their attachments, or
 - 2. HVAC ducts have cross-sectional areas of less than 6 ft².
- D. For piping systems other than pressure piping and fire protection sprinkler piping, seismic protection measures are not required for:
 - 1. Ductile piping designated as having an $I_p = 1.5$ and a nominal pipe size of 1 in. or less when provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical components/systems.

2. Ductile piping designated as having an $I_p = 1.0$ and a nominal pipe size of 3 in. or less.
- E. Friction clamps shall not be used for anchorage attachment of mechanical and electrical components and systems.

3.2 SWAY BRACES

- A. Install sway braces on piping and ducts to preclude damage during seismic activity. Brace piping grouped for support on trapeze-type hangers at intervals not to exceed those shown on drawings.
- B. Do not use bracing rigidly attached to pipe flanges, or similar, where it would interfere with thermal expansion of piping.
- C. Sway Braces for Piping

The bracing requirements shown below are based on flexible piping. Supports for flexible piping must consider an additional amplification of the piping being in resonance with the building.

1. Transverse Sway Bracing

- a. Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15060 HANGERS AND SUPPORTS FOR PIPING AND TUBING.

2. Longitudinal Sway Bracing

- a. Longitudinal sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the design drawings.

3. Vertical Runs

- a. Brace vertical runs of piping at intervals not to exceed those shown on the design drawings.

4. Anchor Rods, Angles, and Bars

- a. Bolt anchor rods, angles, and bars to either pipe clamps or pipe flanges at one end and cast-in-place concrete, or masonry insert or clip angles bolted to the steel structure, on the other end. Use solid metal rods or pipe.

5. Clamps

- a. Apply clamps on uninsulated pipes directly to pipe. Apply clamps to insulated piping over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.

6. Bolts

- a. Bolt anchors to pipe and structure as shown on drawings.

7. Shell Type anchors post installed in reinforced concrete
 - a. The use of lead-cinch drop in anchors is not allowed.

D. Sway Braces for Ducts

1. Transverse Sway Bracing
 - a. Provide transverse sway bracing at intervals not to exceed those shown on design drawings. Walls which ducts penetrate may be considered transverse braces.
2. Longitudinal Sway Bracing
 - a. Provide longitudinal sway bracing at intervals not to exceed those shown on design drawings.
3. Bracing Angles
 - a. Provide bracing angles for rectangular ducts as shown on design drawings.

3.3 SPREADERS

- A. Provide spreaders between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces at intervals not to exceed those shown on design drawings. Apply spreaders to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.

3.4 FLEXIBLE COUPLINGS OR JOINTS

- A. Building Piping
 1. Provide flexible couplings or joints in building piping at bottom of pipe risers as shown on drawings.

3.5 UNDERGROUND PIPING

- A. Install flexible couplings adjacent to buildings in underground piping and conduit, except heat distribution system, as shown on drawings. Provide additional flexible couplings as follows:
 1. On each side of the joints of demarcation between soils having widely differing degrees of consolidation.
 2. At points that can be considered to act as anchors.
 3. On every branch of a tee and each side of an elbow.

3.6 EMERGENCY GAS SUPPLY CONNECTIONS

- A. Provide facilities which are to be connected to natural gas distribution systems with an aboveground locked, valved and capped emergency gas supply connection. Provide for attachment of a portable, commercial-sized gas cylinder system to this connection. Locate connection within 12 inches of the exterior wall, clearly marked with an appropriate metal sign mounted on wall above. Provide an automatic device to safely interrupt the flow of gas to the building in case of an earthquake as shown on drawings.

3.7 ANCHOR BOLTS

- A. Use cast-in-place anchor bolts on floor- or pad-mounted equipment required by any Section of these Specifications, and/or as shown on design drawings. Provide anchor bolts as shown on drawings or conforming to the manufacturer's installation recommendations, whichever is the most stringent. Extend anchor bolts that exceed normal depth of equipment foundation piers into the concrete floor or the foundation as necessary to accommodate bolt lengths. Do not use expansion or chemically bonded anchors without first consulting LANL ESM Chapter 5, Part II, Section II, which places special provisions on the use of such anchors.

3.8 RESILIENT VIBRATION ISOLATION DEVICES

- A. Follow the same procedure as in paragraph entitled "ANCHOR BOLTS" for selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations.

- B. Resilient and Spring-Type Vibration Devices

NOTE: Retain either this paragraph or the one below, as required by the project. Remove the paragraph not needed.

- 4. Use vibration isolation devices shown on design drawings.

- C. Multidirectional Seismic Snubbers

NOTE: Details of multidirectional seismic snubbers will be shown in drawings if paragraph is retained.

- 1. Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or pad-mounted equipment. Use multidirectional seismic snubbers shown on drawings. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical flanged forces are resisted by the snubber medium.

3.9 EQUIPMENT SWAY BRACING

- A. Sway bracing shall be as shown on drawings.
- B. Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Provide braces consisting of angles, rods, bars, or pipes arranged and secured as shown on drawings. Submit details of equipment bracing for approval.

3.10 FLOOR- OR PAD-MOUNTED EQUIPMENT

- A. Floor- or pad-mounted equipment shall be bolted to the floor/pad as shown on drawings

3.11 SUSPENDED ACOUSTICAL CEILING ASSEMBLIES

- A. Suspended acoustical ceiling assemblies shall be installed in accordance with Section 09510, Suspended Acoustic Ceilings.

3.12 FUME HOOD DISCHARGE STACKS

- A. Construct and support stacks as shown on drawings.

3.13 CRANES

- A. Provide cranes as shown on drawings. Submit to LANL a proper certification that the crane system has been checked for seismic forces as specified in ESM Chapter 5, Part II, Sect. 2 and found satisfactory.

3.14 RAISED/ACCESS FLOOR SYSTEMS

- A. Construct raised/access floor systems as shown on drawings.

3.15 OTHER COMPONENTS AND SYSTEMS

- A. Construct the following specific items of equipment to be furnished under this contract as shown on drawings.

Miscellaneous Equipment

Chillers

Air-Handling Units

Cooling Towers

Transformers

Switchboards

Motor Control Centers

Panel Boards

Free Standing Electric Motors

3.16 SEISMIC QUALIFICATION OF NONSTRUCTURAL COMPONENTS

NOTE: Include this paragraph only when testing for seismic-resisting components is required by ESM Chapter 5, Part II, Sect. 2.

The designer must indicate on the drawings all locations and all features for testing that are required in accordance with ESM Chapter 5, Part II, Sect. 2. This includes indicating the locations of all structural components and connections requiring testing.

Add any additional requirements as necessary.

- A. Testing for seismic-resisting components shall be as called for on drawings.

END OF SECTION

Do not delete the following reference information:

FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 3, dated June 23, 2004.